Space Weather Technical Forecast

Issued on Wednesday, 05 June 2024 at 11:53 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Mainly Moderate activity throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two M-flares observed from AR3697, peaking M3.4 at 05/0856 UTC, followed by an M2.6 at 05/1007 UTC. This region continued to lose leader spots, but saw a gradual growth of penumbra around its trailer. Separation of the opposite polarity umbra also resulted in the loss of the delta-spot configuration, however the spot remained active, with a broad area of complex magnetic looping evident over the region in SOD imagery. Slight growth was also evident in AR3698 in the northwest and AR3703 in the south-centre disc, however these persisted as simple and inactive bipolar regions. The other regions remained small and simpler.

No Earth-directed CMEs have been observed in available imagery, however this doesn't include the period since the two M-flares.

Solar Wind / Geomagnetic Activity: Solar winds, observed by ACE at L1, have been slightly elevated at 400-450km/s, with a brief enhancement to 500km/s around 05/0300 UTC, before easing again. This is perhaps attributable to a weak CME glance that was expected, but this is low confidence. Furthermore, density has been rising since this slight enhancement, from below average levels to above average by 05/1200 UTC. This perhaps suggests the potential for an arrival to yet occur. Interplanetary Magnetic Field (IMF), Bt, remained weak, below 8nT, with north-south component also weak, ranging +/- 5nT, but initially mainly positive, before becoming more variable from 05/0300 UTC. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 persisted at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at background with the associated 24-hour fluence well below Active. Observed fluence at 05/0000 UTC was 1.17e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with further M-class flares likely and a slight chance of isolated X-class flares, these mainly from AR3697.

Solar Wind / Geomagnetic Activity: There remains a slight chance of influence from the glancing of the M7.3 flare CME which occurred 01/1940 UTC, however this is low confidence. Otherwise, background to slightly elevated winds are expected, but with a chance of an enhancement later on day 4 (08 Jun) due to the onset of fast winds from CH42/+. Geomagnetic activity is expected to be mainly Quiet with Unsettled intervals, but with a chance of a spell of Quiet to Unsettled and a slight chance G1 Minor Storms. This due to either the CME glance day 1 (05 Jun) or the CH onset day 4 (08 Jun).

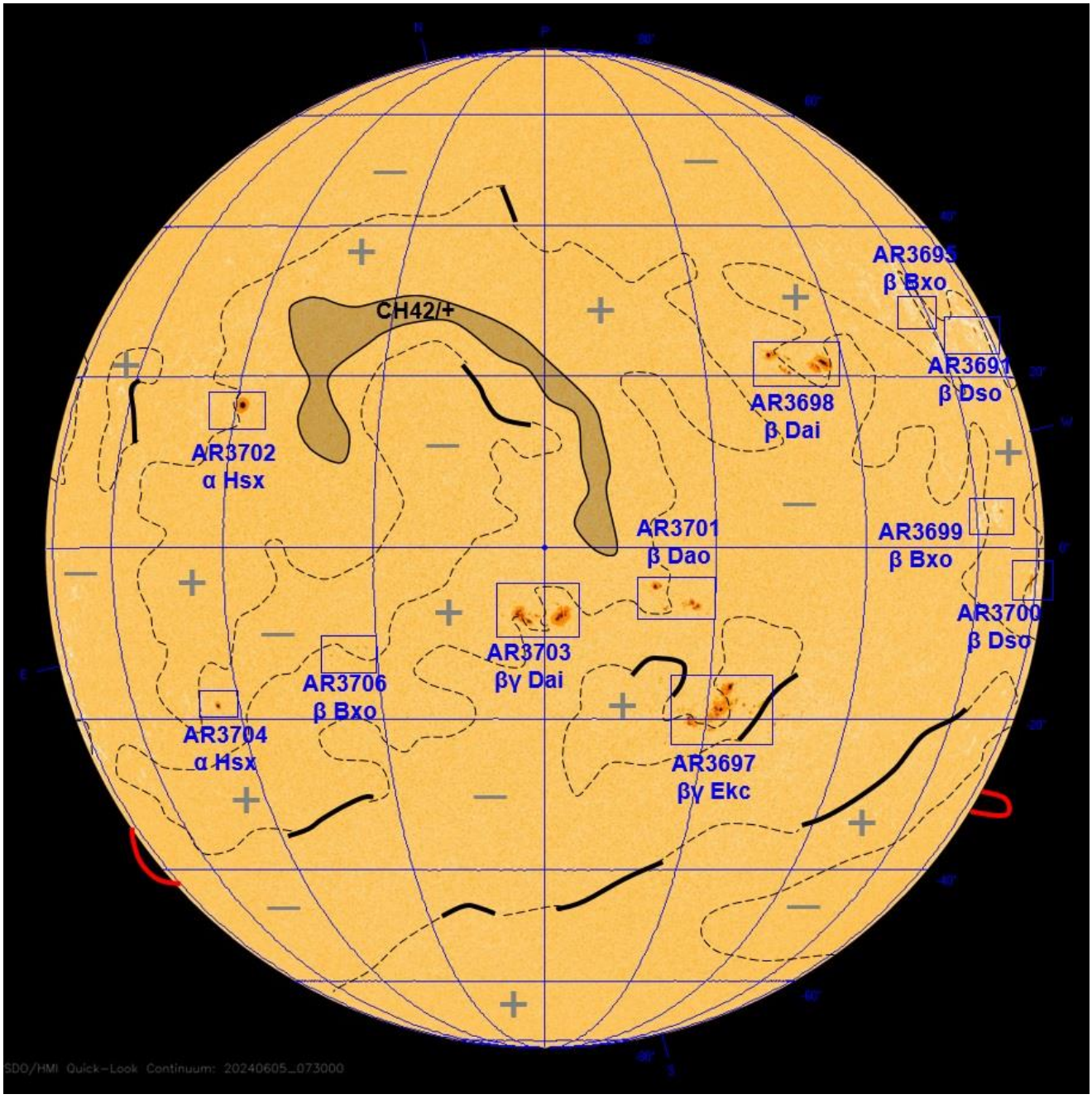
Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background, with only a slight chance of enhancement given any notable flares. High energy electron flux is forecast to persist at background, with the associated 24 hour fluence forecast to

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

remain below the Active threshold.

Figure 1. Solar Analysis Valid 0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

CME from the M7.3 flare on 01/1940 UTC either gave a weak glance early on 05 Jun, or is still yet to arrive. This was low confidence for any Earth-directed impact, but brings a slight chance of Active to G1 Minor Storms. No other Earth-directed CMEs have been observed in available imagery.

Slightly elevated solar winds are expected to ease to background, before the next potential enhancement. This is most likely to be from Central disc CH42/+ has the potential to give a further slight enhancement to the solar wind later on day 4 (08 Jun), however this is low confidence due to limited enhancement currently in MOSWOC Enlil and the lack of evidence from the previous rotation, which was dominated by the arrival of fast CMEs

Overall, Quiet geomagnetic activity is expected with Unsettled intervals, but with a chance of a spell of Unsettled to Active and a slight chance of G1 Minor Storms, either day 1 (05 Jun) from any CME arrival or day 4 (08 Jun) from any coronal hole fast wind onset.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
02/0048	Partial	M7.3 flare AR3697	SE	700km/s	05/0000 UTC +/-12 hrs	Possible already glanced 05/0300 UTC but uncertain. Glancing blow still possible.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2a: MOSWOC Enlil and ensemble Overdue CME arrival shown.

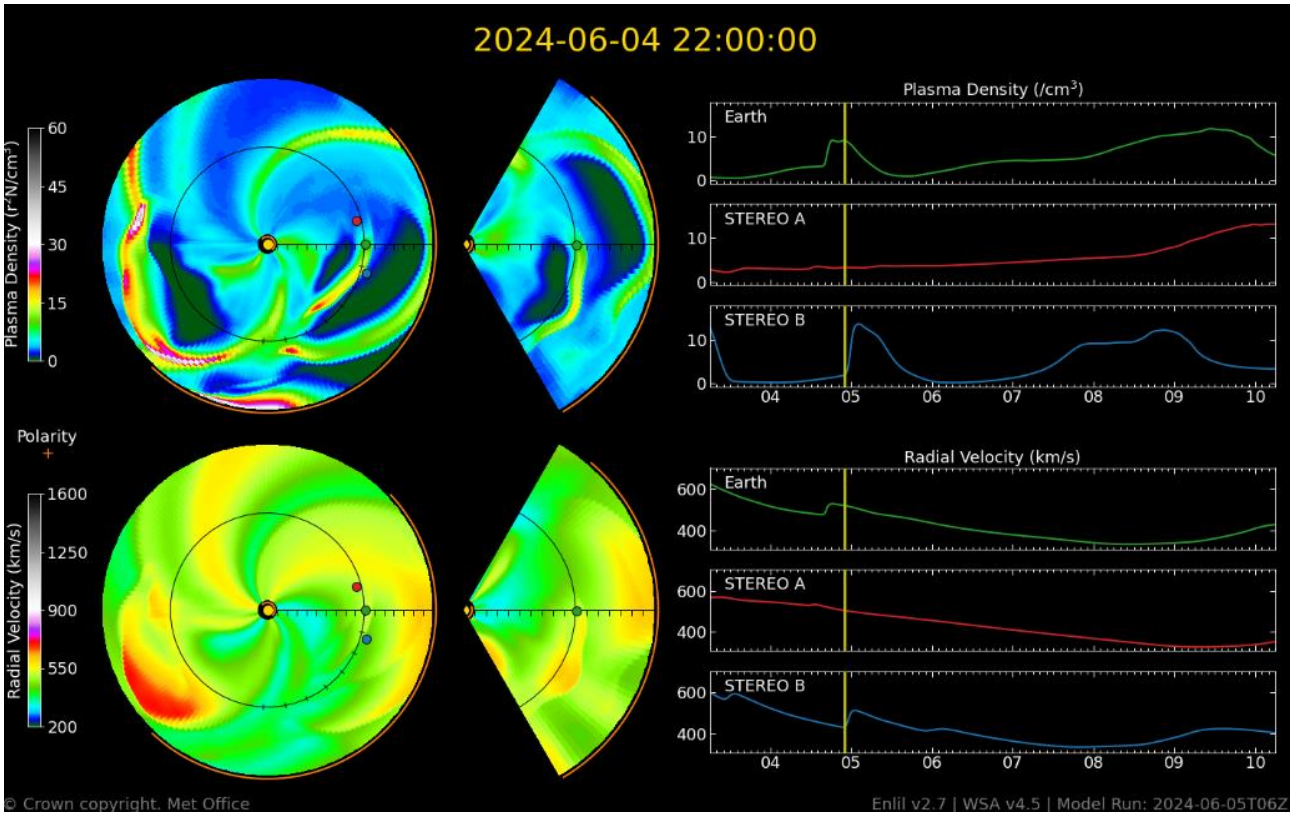
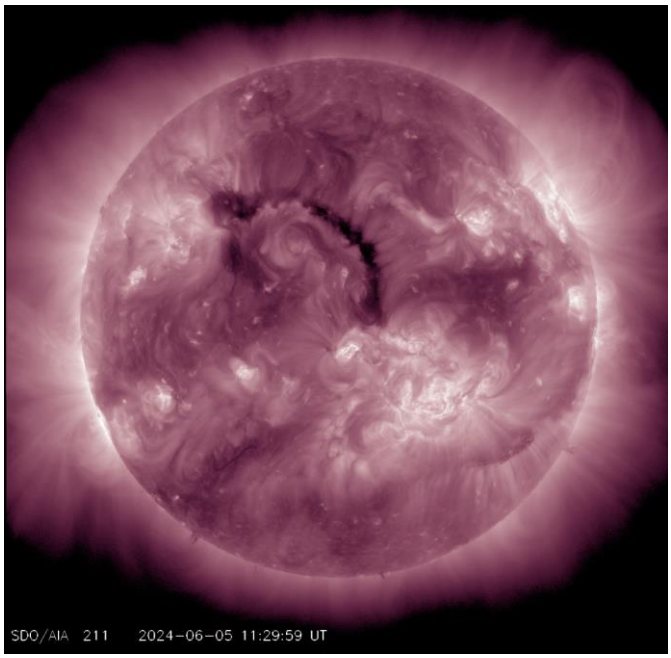


Figure 2b: SDO aia-211 showing central disc CH.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

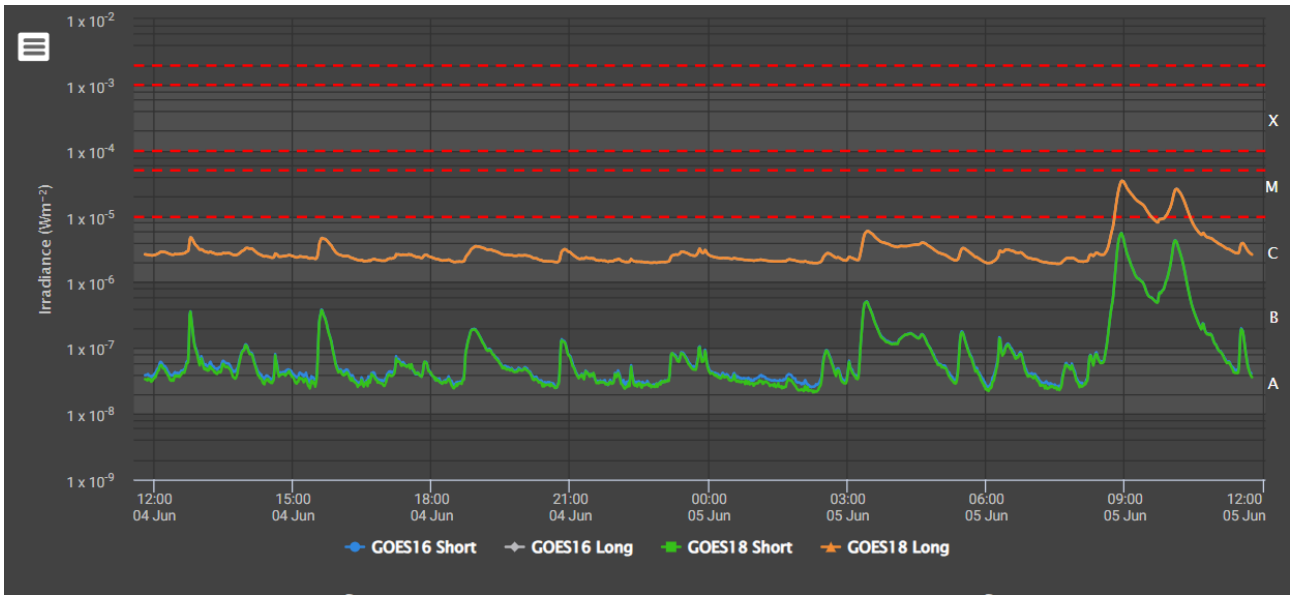
Radio Blackouts - X-Ray Flares:

Mainly Moderate activity is expected with occasional M-flares and a slight chance of X-class flares.

There are eleven active regions on the visible disc, however the main driver of the X-flare risk remains active sunspot AR3697. This has lost its main leader region, but persists as a magnetically complex and relatively unstable spot, The region has also seen recent growth in penumbral area, but now only has a few smaller and weaker umbral cores compared to the regions previous very active phase. The other regions remain relatively inert, however some small growth was observed from AR3698 in the northwest, along with slight complexification of AR3703 in the south-centre disc. Both these regions remained inactive, however.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	70	65	60
Very Active	R3 to R5 X Class	No	15	10	10	5

Figure 3: GOES-16/18 X-ray flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background. AR3697 is now much reduced compared to its previous active phase, but still contains the potential for further large M-class or perhaps X-class flares. Alongside the other active regions, predominately those on the western disc, this gives a slight chance of proton flux rising towards, and potentially exceeding S1 Minor Radiation storm.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux, as observed by GOES-16, is expected to persist at mainly background levels, with no notable sources of potential enhancement currently anticipated. The associated 24 hour electron fluence is expected to remain well below the Active level, as supported by MOSWOC REFM, which is currently thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.